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TIRE-TUBE METHOD OF FENCE POST TREATMENT

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UNITED STATES DEPARTMENT OF AGRICULTURE
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Madison, Wisconsin
In Cooperation with the University of Wisconsin

TIRE-TUBE METHOD OF FENCE-POST TREATMENT

By

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Fence posts of nondurable wood can be made to have 20 to 30 years life, or even more, by thorough pressure treatment with coal-tar creosote or mixtures of creosote with other suitable oils. Similar results can be obtained with these preservatives by the hot-and-cold bath method of treatment described in Farmers' Bulletin 744, "The Preservative Treatment of Farm Timbers." This can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 5¢ a copy (stamps not accepted). Hundreds of thousands of posts treated by these methods are now in successful service throughout the country. Many farmers and other post users have failed to take advantage of these treatments, however, and are continuing to use short-lived, untreated posts. While thorough impregnation with creosote is highly effective and economical, the cash outlay required for such treatment is considerable. No better treatment for posts is known but, if it is necessary to keep the cash outlay as low as possible, some other method will often have to be used.

One of the simplest and cheapest methods that can be used with assurance of good durability is the tire-tube method, illustrated in figure 1, which is an adaptation of the old Boucherie process. It consists in treating thoroughly green, round posts with the bark on by forcing preservative solution endwise through the sapwood portion of the post. The method is not recommended for split or sawed posts, or posts that have started to season. In making the treatment, the bark is peeled for a distance of 4 to 6 inches from the large end of the post, to provide a smooth, clean surface. A section of old inner tube about 2 or 2-1/2 feet long, cut from a used tire, is then slipped over the peeled surface and bound in place with cord, wire, rubber band, or any other convenient and suitable material. The post is then laid on a rack with the large end about 1-1/2 feet or more higher than the small end. The loose end of the tire section is then fastened to a frame so that the preservative cannot spill out but will be kept in close contact with the end of the post, and a measured amount of preservative solution is poured in. In a short time the preservative will begin to flow into the sapwood of the post, forcing the natural sap out at the small end. When all the preservative has flowed from the tire tube into the wood, the tube is removed and the post is taken from the rack.

The length of time required for the preservative to flow into the wood will vary with the quantity used, the kind and condition of the wood, season of the year, thickness of sapwood, and other factors. With aspen posts 7 feet long, 8 to 24 hours were usually sufficient. Most rapid treatment outdoors can be expected during warm weather. The preservative will flow into wood more slowly during cool weather and outdoor treatment by this method in freezing weather will usually not be practical. If posts are brought indoors for treatment in freezing weather they should be allowed to thaw out thoroughly before the treatment is begun.

Green Posts Required

The tire-tube method is suitable only for wood that is thoroughly green. The sooner posts are treated after cutting the better. If possible, they should be treated within 24 hours, especially in hot, dry weather. If the ends have dried too much they should be cut off for an inch or so until wet surfaces are exposed. If the posts must be held longer before treatment, the ends may be coated with paint or similar material that will retard drying; then when ready to treat, an inch or more of wood can be sawed from each end. If it is convenient to keep the posts submerged in water (not floating) they will remain in good condition for treatment for many weeks. The important requirement is that there shall have been no drying of the end surface that the preservative must enter.

The Apparatus

Sections of inner tubes from used automobile or truck tires constitute the most important part of the treating apparatus. The sections should be about 24 to 30 inches long and free from leaks. Small leaks may be stopped with cold tire patches or with small clamps like those used in chemical laboratories. A small clamp that will serve for this purpose can be made with two small pieces of wood about 1/4 by 3/4 by 2-1/2 inches in size with a 1/8-inch stove bolt through their center to draw them together (fig. 2, A, B). Used tubes can usually be obtained very cheaply from garages or junk yards. It is always best to use tubes that are somewhat smaller than the posts on which they are to be placed, in order to get a tight connection. In attaching the tube it is merely doubled back over itself for about 4 to 6 inches and the folded edges stretched over the end of the post. The doubled-back portion is then easily unrolled into place. If the peeled surface is irregular it is well to spread axle grease or similar material over it before unrolling the doubled-back portion, to avoid leakage. After a few posts have been treated, experience will indicate the type of surfaces that will require coatings of grease.

A very simple, homemade stretcher that will simplify slipping a small tube on a large post is shown in figure 2, C. It can be made of 4 to 6 smooth hardwood sticks about 3/4 by 1-1/2 by 24 inches in size

that are tapered at one end and held together by rubber strips cut from a tire tube. Two stretchers will be convenient if both large and small posts are to be treated; one for small posts with 4 sticks and another for large posts with 6 sticks. By using the stretcher in the manner illustrated in figure 3, small tubes can be made to stretch over fairly large posts with relative ease.

After the tube is on it should be tied in place by several wrappings of cord, wire, rubber band or other suitable material, to prevent leakage of preservative. A strip of inner tube about 1-1/2 inches wide and about 4 feet long will serve very well for the purpose. A single wrapping of No. 12 wire, tightly twisted with pliers, will also be useful for this purpose. Leakage at depressions on the surface of a post can be stopped by tapping the wire into the depressions.

Any convenient support or rack may be used that permits the small end of the post to be 18 inches or more lower than the large end, provides a means for holding the loose end of the tire tube, and allows the drip to escape freely from the post. Low racks will generally be found most convenient for lifting and moving the posts. The loose end of the tube may be tied to the supporting frame with rope or cord. Small "C" clamps are very convenient for this purpose. If preferred, the posts may be allowed to stand upright against any convenient support.

If the drip from the posts is to be saved for mixing new solution, provision must be made to catch it in a suitable tank or barrel. A good weighing scale should be available, also accurate measuring cans for measuring water and solution. Cans or pails marked off in gallons and quarts will generally be useful.

If a large number of posts are to be treated the apparatus should be selected with considerable care, so as to make all operations as convenient as possible. Much unnecessary labor can thus be avoided.

The Preservative

Only preservatives dissolved in water may be used, for oils will not penetrate satisfactorily when applied to green wood in this manner. Various proprietary and nonproprietary preservatives in water solution can undoubtedly be employed. At present, however, zinc chloride seems most promising because of its cheapness, availability, safety, and convenience, combined with moderate effectiveness.

Zinc chloride is available in three forms: Granulated, fused, and concentrated solution. In the granulated form it is in dry, white grains or small pieces which dissolve readily in water. It must be shipped in airtight containers for, when exposed to the air, it quickly takes up moisture and the grains stick together or even melt in the

absorbed water. When using this form, therefore, it is desirable to mix the entire contents of the container with water at one time whenever practicable. If any unused granules must be left in the container it should be tightly closed as quickly as possible.

The fused form is very inconvenient to handle in small quantities. It is shipped as a solid mass inside of an airtight container. It can be dissolved slowly by chopping holes in the container and placing both container and contents in the water or the container may be chopped to pieces and thus removed from around the zinc chloride mass. Since fused zinc chloride, when purchased in small quantities, is no cheaper than the granulated form, and may even be more expensive, there is seldom any advantage to the small consumer in using it.

The most convenient form of zinc chloride for small users is the concentrated solution. Various manufacturers ship the solution in different strengths, usually about 48 to 72 percent. The purchaser should know what strength of solution is being furnished so that he may know how much water to add to make the proper treating solution, as well as what the zinc chloride part of the solution is costing him. The solution form is usually the cheapest to buy, except where there is a long freight haul. Since the solution is generally about half water the freight cost will be higher than on an equal amount of zinc chloride shipped in the dry form.

The cost of zinc chloride will vary considerably with the quantity purchased, the sizes of the containers, the form (whether granulated, fused, or solution), and other factors. In solution form prices as low as 3 or 4 cents per pound (equivalent to about 6 to 8 cents per pound for the zinc chloride in the solution) are sometimes quoted when several hundred pounds are purchased. To this cost freight must be added. In smaller quantities the prices are likely to be higher. Since the prices vary so widely the prospective purchaser should ask for prices from several companies on both the dry form and the solution form, stating the quantity desired. If the prices quoted include freight they will simplify comparing the net delivered cost, but usually they will be quoted f.o.b. the dealer's warehouse and the purchaser will have to determine the freight cost in order to make comparisons. A list of producers and dealers in zinc chloride is appended to this publication.

In asking for prices it should be stated that the zinc chloride is to be used for wood preservation and the dealer should be asked to state the purity of his product or the concentration of zinc chloride, if in solution. The American Wood-Preservers' Association requires that in the solid form there shall be at least 94 percent of zinc chloride and not more than 0.1 percent iron. A moderate amount of impurities is not objectionable. A 100 percent pure product would be very satisfactory, but usually too expensive.

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Preparing the Treating Solution

While the work done thus far indicates that a 10 percent solution of zinc chloride will be suitable for treating posts of many species by the tire-tube method it is known that it will not be satisfactory for certain species that will be discussed later.

If the zinc chloride has been purchased in granulated or fused form, and is reasonably pure, a solution of approximately 10 percent strength can be made by mixing in the proportion of 10 pounds of the solid zinc chloride to 90 pounds of water. If the zinc chloride is 95 percent pure about 10-1/2 pounds will be required for 90 pounds of water. It is not practical to measure quantities of solid zinc chloride and, even with water, weighing is generally more accurate than measuring. However, when it is too inconvenient to weigh the water it may be measured. A gallon of water at a temperature of about 60° F. weighs about 8-1/3 pounds. For 10-1/2 pounds of 95 percent pure zinc chloride, therefore, about 10-3/4 gallons of water are required to make a 10 percent solution.

If the zinc chloride has been purchased in concentrated solution the amount of water required will depend upon the concentration. Table 1 shows the approximate proportions of concentrated solution and water required for the different strengths of zinc chloride solution commonly available, to produce a treating solution of 10 percent strength.

Table 1

Strength of concentrated solution	Approximate amount of water to be added to 10 pounds of concentrated solution to make a 10 percent treating solution	
Percent	Pounds	Gallons
48-1/2	38-1/2	4-1/2
50	40	4-3/4
70	60	7-1/4
72	62	7-1/2

Amount of Solution per Post

It is considered good practice to have the posts absorb about 1 pound of zinc chloride per cubic foot of wood. For this reason different amounts of preservative solution are required for posts of different size. Table 2 will be helpful in determining the amount of 10 percent solution to use for individual posts.

Table 2.--Amounts of 10 percent zinc chloride solution required for posts of different sizes

Average middle diameter of post, inside bark	Approximate amounts of solution for posts that are:											
	6 feet long		7 feet long		8 feet long		10 feet long		12 feet long	
Inches	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons	Pounds	Gallons
A	B	C	D	E	F	G	H	I	J	K
3	3	1/4	3-1/2	1/2	4	1/2	5	1/2	6	3/4
3-1/2	4	1/2	4-3/4	1/2	5-1/4	1/2	6-3/4	3/4	8	1
4	5-1/4	1/2	6	3/4	7	3/4	8-3/4	1	10-1/2	1-1/4
4-1/2	6-3/4	3/4	7-3/4	3/4	8-3/4	1	11	1-1/4	13-1/4	1-1/2
5	8-1/4	1	9-1/2	1	11	1-1/4	13-3/4	1-1/2	16-1/4	1-3/4
5-1/2	10	1	11-1/2	1-1/4	13-1/4	1-1/2	16-1/2	1-3/4	19-3/4	2-1/4
6	11-3/4	1-1/4	13-3/4	1-1/2	15-3/4	1-3/4	19-3/4	2-1/4	23-1/2	2-1/2
6-1/2	13-3/4	1-1/2	16-1/4	1-3/4	18-1/2	2	23	2-1/2	27-3/4	3
7	16	1-3/4	18-3/4	2	21-1/2	2-1/4	26-3/4	3	32	3-1/2
7-1/2	18-1/2	2	21-1/2	2-1/4	24-1/2	2-3/4	30-3/4	3-1/4	36-3/4	4
8	21	2-1/4	24-1/2	2-3/4	28	3	35	3-3/4	42	4-1/2
8-1/2	23-3/4	2-1/2	27-1/2	3	31-1/2	3-1/2	39-1/2	4-1/4	47-1/4	5-1/4
9	26-1/2	3	31	3-1/2	35-1/4	4	44-1/4	4-3/4	53	5-3/4
9-1/2	29-1/2	3-1/4	34-1/2	3-3/4	39-1/2	4-1/4	49-1/4	5-1/2	59	6-1/2

The average middle diameter of a post (for use with table 2) is found by averaging the diameters of the two ends, the measurements being taken inside the bark. When the ends of a post are not true circles, which is very often the case, it is desirable to measure the diameter at each end in more than one direction and thus obtain an approximate average figure. The average diameters obtained in this way for the two ends are then averaged together to give the average middle diameter. A high degree of accuracy is not necessary.

The following example illustrates how table 2 can be used to determine the amount of 10 percent zinc chloride solution required to treat a post of a known size. Suppose a post is 7 feet long and has an average middle diameter of 4-1/2 inches. The amount of 10 percent solution required will be found in column D in pounds or column E in gallons, on the line with the 4-1/2 in column A. They show that about 7-3/4 pounds or about 3/4 gallon will be required to treat the post. Similarly it will be found that an 8-foot post with an average middle diameter of 7 inches will require 21-1/2 pounds or about 2-1/4 gallons.

Waste of Solution

Although most of the liquid that drips from the end of the post during treatment is the sap of the tree (mostly water), it will usually contain some zinc chloride. In all species treated at the Forest Products Laboratory, except the oaks and hickories, the quantities of zinc chloride in the drip was found to be small, generally less than one-tenth of a pound. The drip from the oaks and hickories, however, contained fairly large amounts of zinc chloride. The zinc chloride in the drip need not be wasted if the drip is saved and used in the preparation of additional solution. For practical purposes drip containing small amounts of zinc chloride may be regarded as water, that is, no consideration need be given to the small amount of preservative that it contains. The sugar and other materials contained in the sap are in such small quantity that they need cause no concern, even if the solution becomes discolored. When the zinc chloride in the drip is quite large account should be taken of it in making up additional solution. Further discussion of this point will be found in the heading "Species of Wood".

Cans under the posts or a trough sloping downward to a large container are convenient for collecting the drip.

Summary of Treating Operation

The following summary of the foregoing discussion indicates the different treating operations and the order in which they should follow each other:

1. Peel bark from large end of post for about 4 to 6 inches, leaving a smooth, clean surface so that a tight joint can be made between wood and rubber. (If the end surfaces of the posts are dry, cut the ends back until wet wood is exposed).

2. Double back the end of the tube and place it on the large end of the post. If it is necessary to use a tube much smaller than the post, the stretcher simplifies the job.

3. Grease the peeled surface (if your experience indicates that grease is necessary to make a joint that does not leak).

4. Unroll the doubled-back portion of the tube and bind it tightly.

5. Place post on rack.

6. Fasten up loose end of tube.

7. Pour in measured amount of preservative solution.

8. After preservative has all flowed into the wood remove tube and place post in storage pile.

Species of Wood

Experiments with the tire-tube method thus far do not cover a large number of species of wood and it is not yet known that all species will take treatment satisfactorily. Good treatments have been obtained at the Forest Products Laboratory in aspen (popple), butternut, American elm, basswood, black cherry, jack pine, loblolly pine, soft maple, red gum, tamarack, willow, bitternut and shagbark hickory, and burr, red, and white oak. Other investigators have reported that sugar maple, red pine, pitch pine, northern white pine, eastern hemlock, black oak, hickory, spruce, yellow poplar, beech, and black gum are capable of treatment by the method. The results thus far indicate that good treatment can probably be obtained in most species that have a substantial thickness of sapwood.

The results obtained at the Forest Products Laboratory indicate that 10 pounds of a 10 percent zinc chloride solution per cubic foot will result in a satisfactory treatment for aspen (popple), American elm, black cherry, loblolly pine, soft maple, tamarack, and willow.

Basswood, jack pine, and red gum appear to require a larger quantity of a weaker solution. The results suggest that 20 pounds of a 5 percent solution per cubic foot will give a satisfactory treatment. Solutions roughly approximating 5 percent in strength can be made by doubling the quantities of water recommended for making 10 percent

solutions. For example, a solution of roughly 5 percent can be made by mixing 10-1/2 pounds of 95 percent pure granulated or fused zinc chloride with 180 pounds of water or by adding 80 pounds of 9-1/2 gallons of water to 10 pounds of a 50 percent solution of zinc chloride.

The treatments made on the oaks and hickories showed fairly large amounts of zinc chloride present in the drip. In order to leave the desired retention of 1 pound per cubic foot in posts of these species an excess of zinc chloride was required to treat them. The results indicated that a satisfactory treatment can be obtained by using about 15 pounds of a 10 percent solution per cubic foot but on the average at least one-third of the zinc chloride in the treating solution will be present in the drip. The zinc chloride in the drip should be taken account of in making up additional solution so that the treating costs for posts of these species will not be higher than necessary. A sufficiently reliable method for determining the amount of zinc chloride in the drip consists of obtaining the specific gravity of the drip with an hydrometer, from which the strength of the solution can be determined. By multiplying the weight of the drip by its strength the weight of the zinc chloride is obtained.

The relationship between the specific gravity and strength of zinc chloride solutions for the range most likely to be encountered in the drip when treating the oaks and hickories is given in table 3.

A very rough method of taking account of the zinc chloride in the drip does not require a hydrometer. In this method it is assumed that about one-third of the salt in the treating solution will be in the drip. The method can probably best be explained by an example. Assume that four oak posts, 7 feet long with average middle diameters of 4, 5-1/2, 6, and 7 inches are to be treated. From table 2 it is found that the quantities of solutions required are 6, 11-1/2, 13-3/4, and 18-3/4 pounds, respectively. Since 15 pounds is recommended for the oaks and hickories these quantities must be increased by one-half so that 9, 17-1/4, 20-5/8, and 28-1/8 pounds, respectively, or a total of 75 pounds will be required. Ten percent of the total solution, or 7-1/2 pounds, will be zinc chloride

$$\left(\frac{10 \times 75}{100} = 7\text{-}1/2\right).$$

It is assumed that one-third of the zinc chloride, or 2-1/2 pounds, will be in the drip when the treatment of the posts is completed. Suppose this drip is to be used in making up 200 pounds of a 10 percent solution. This quantity of solution would require about 20 pounds of dry zinc chloride and about 180 pounds of water. If the total weight of the drip from the four posts was found to be 30 pounds it is assumed that 27-1/2 pounds of this is water since we have already assumed that 2-1/2 pounds is zinc chloride. By using the drip, 17-1/2 pounds of new zinc chloride (20 minus 2-1/2) and 152-1/2 pounds of water (180 minus 27-1/2) would be required to make 200 pounds of a 10 percent solution.

Table 3.--Relationship between specific gravity and strength of zinc chloride solutions

Specific gravity at 60° F. (As read on the hydrometer)	Strength of zinc chloride solution
	Percent
1.0000	0.00
1.0069	.76
1.0140	1.53
1.0211	2.29
1.0284	3.05
1.0357	3.81
1.0432	4.63
1.0507	5.45
1.0584	6.27
1.0662	7.09
1.0741	7.91
1.0821	8.78
1.0902	9.65
1.0985	10.52
1.1069	11.39
1.1154	12.26
1.1240	13.21

Thickness of Sapwood

Since, in most species, the penetration of the preservative is confined almost entirely to the sapwood, the thickness of the sapwood on the posts determines the thickness of the treated zone. It is not known how much influence the thickness of the sapwood will have upon the life of the treated post. It is considered desirable, however, to have sapwood at least 1 inch thick on 4- to 5-inch diameter posts. On larger posts it is best to have a wider sapwood band. If posts with thinner sapwood than that recommended must be used they will undoubtedly be benefited by the treatment, but possibly not so much as those with thick sapwood. It is doubtful that the treatment will be economical on posts with durable heartwood and narrow sapwood. Such posts give long life without treatment.

Penetration

Although the penetration of the preservative, in most species, will be limited almost entirely to the sapwood, there may be slight penetration in the exposed heartwood at the ends of the post, especially the end to which the tube is attached. Some preservative may also diffuse into the heartwood in the interior of the post. At the end of the treating period the penetration, even in the sapwood, is likely to be streaked and incomplete, particularly near the small end of the post. Diffusion of preservative continues after the tube is removed, however, as long as the post remains in the green condition, and the preservative will be more uniformly distributed after the posts are stored for a while than it will be immediately after treatment. It is a good plan, therefore, to allow the bark to remain on the posts for a week or two, or even longer, after the treatment is finished.

Removal of Bark

If desired, the posts may be set in the ground without removing the bark but it is believed that longer life will be obtained from posts that are peeled before being set.

The end of the post to which the tube was attached will be the most thoroughly treated and, therefore, should always be set in the ground.

Coating Ends of Posts

While it is not necessary to coat the exposed wood it is believed that suitable coatings will be helpful in prolonging the life of the posts. A thick coating of tar, asphalt paint, pitch, or other similar material that will have a moisture retarding effect should reduce the rate at which the preservative is dissolved out of the wood by the water in the soil. If the posts are peeled before setting in the ground, the coating may be applied to all the underground parts and to the top end surface, leaving the remainder uncoated. If the bark is left on, the coating may be applied to the end surfaces and any other spots where bare wood is exposed. Coating the top end of the post should retard the checking of the wood at that point. Such coatings, when used alone, do not preserve the wood from decay, but when used over zinc chloride treated wood it is believed that they will have a useful effect. It is best to allow the posts to season for a few weeks so that the surfaces become dry before applying the coatings. Since no records are available thus far on the life of posts without such coatings, in comparison with similar posts coated, it is not possible to say how much increase in life will be obtained by the use of the coatings.

How Long Will the Posts Last?

The tire-tube method of treating posts with zinc chloride is new and there has not been time to determine how many years the treated posts will last in a fence. Undoubtedly the life will be different with posts of different species, different sizes, different soils, and in different parts of the country. The life will be longer in comparatively dry soils than in wet soils, and longer in cold climates than in warm climates. Longer life will probably be obtained from posts with thick sapwood than from those with thin sapwood. Similarly, posts with the ends coated should last longer than those that are not coated.

While no average life figures have been obtained on posts treated by the tire-tube method some information is available on the life of posts treated with zinc chloride by other methods. This information indicates that posts containing about 1 pound of zinc chloride per cubic foot can reasonably be expected to last 10 to 15 years under ordinary conditions and, in some cases, they may last longer. This means that round posts of nondurable woods, such as aspen (popple), sap pine, and the like can at small cost be made to be about as durable as good cedar posts used without treatment. The Forest Products Laboratory has within the last 2 years, established several service tests of tire-tube treated posts. These tests will eventually yield average life figures on the species of posts in test.

Service Records

It will be helpful if those who use the tire-tube method of treating posts will keep records showing the kind and sizes of the posts, and the date and number installed in different fences. Records should then be made year by year showing the number of treated posts removed and the reason for their removal. Since line fences are seldom disturbed they offer the best opportunity for studying the length of life obtained from posts.

Other Uses

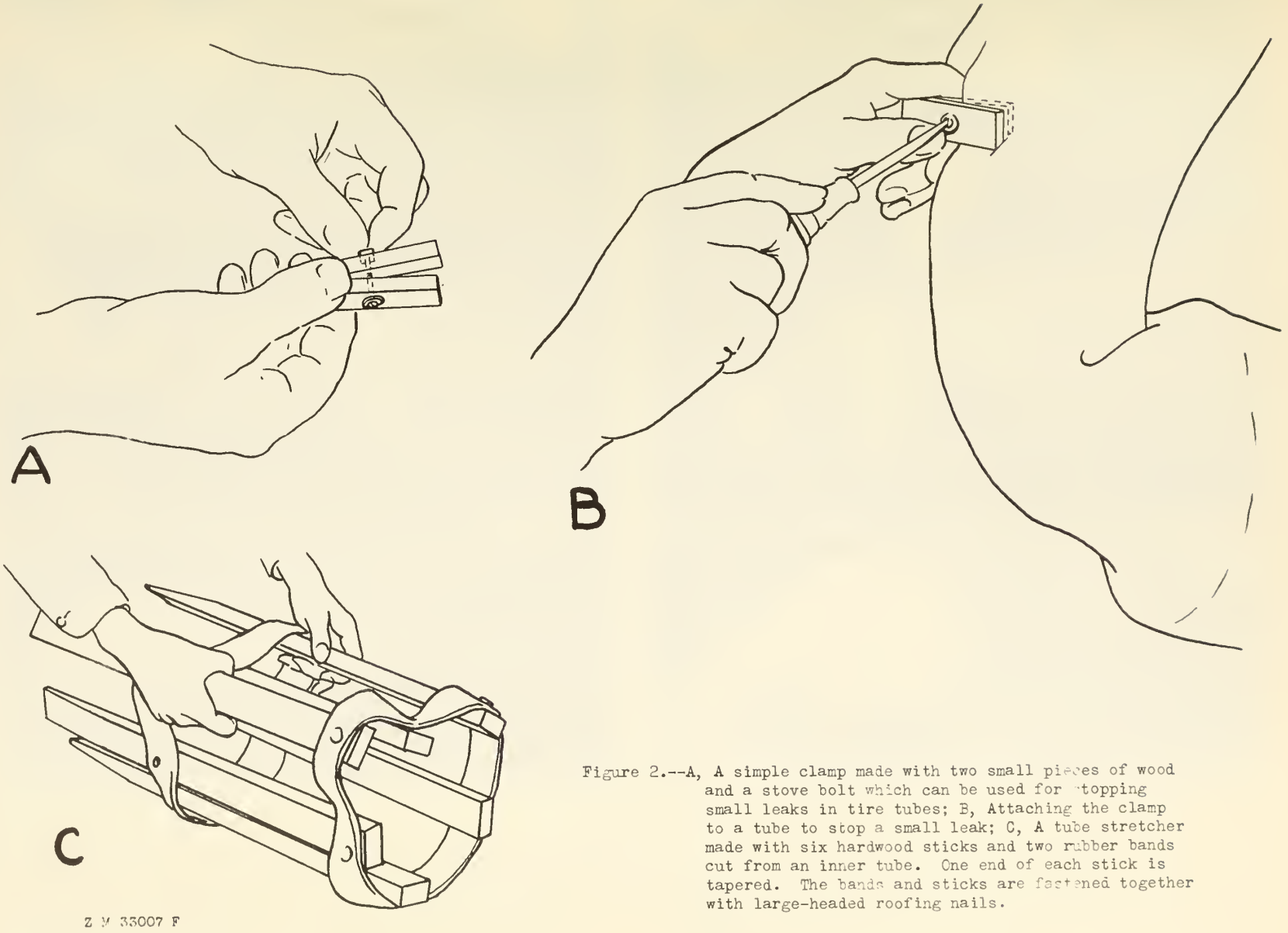
While the previous discussion has applied specifically to fence posts this method of treating can also be used for other classes of material used in the round form, such as poles, tobacco shade posts, rustic furniture exposed to outdoor conditions, log buildings, and log bridges.

Treating Trees With Branches On

Standing trees or freshly felled trees with their branches on can be treated in the sapwood by adaptations of the Boucherie process worked out by the U. S. Bureau of Entomology & Plant Quarantine, Department of Agriculture, Washington, D. C. Instructions for making these treatments can be obtained by writing to that Bureau. A description of the method will also be found in the Journal of Forestry, Vol. 39, No. 1 , January 1938.

Figure 1.--Fire tube method of treating fence posts.

ZM 32857 F



Z M 33007 F

Figure 2.--A, A simple clamp made with two small pieces of wood and a stove bolt which can be used for stopping small leaks in tire tubes; B, Attaching the clamp to a tube to stop a small leak; C, A tube stretcher made with six hardwood sticks and two rubber bands cut from an inner tube. One end of each stick is tapered. The bands and sticks are fastened together with large-headed roofing nails.

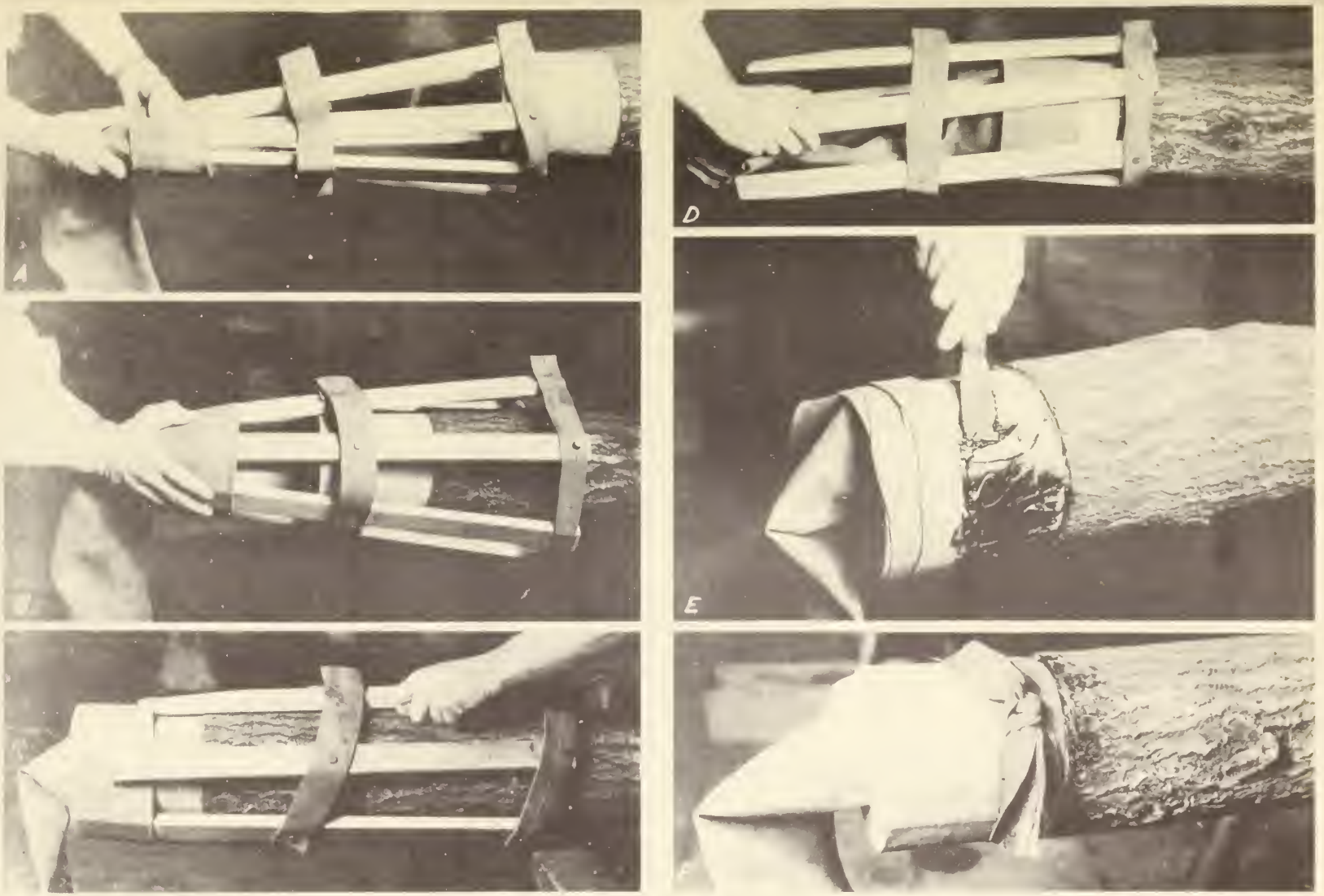


Figure 3.—Attaching the tube to a post with the help of a stretcher.

(A) First the doubled-back portion of the tube is put over the ends of the stretcher sticks that are tapered. The other end of the stretcher hangs on the pooled end of the post.
(B) The stretcher sticks are then pushed over the end of the post causing the tire tube to stretch as it moves toward the post.
(C) After the doubled-back portion is slipped over the end of the post the stretcher sticks are slipped out from under the tube one at a time.
(D) After all the sticks are out from under the tube, the stretcher is taken away by slipping it back over the tube.
(E) Spreading grease or similar material on wood to avoid leakage.
(F) After the grease is spread the tube is unrolled and tied with a rubber band cut from a tire tube.

Z M 33008 F

ZINC CHLORIDE PRODUCERS AND DEALERS IN THE UNITED STATES

Company and address	Location of branch offices, distributing points, and plants	Form	Units in which obtainable (See note at end of list)
American Smelting & Refining Co., 120 Broadway, New York City.	Perth Amboy, N.J. Alton, Ill. Omaha, Nebr. Selby, Calif.	Fused	Large amounts
C. G. Buchanan Chemical Co., Station H, Cincinnati, Ohio.	Cincinnati, Ohio	Granulated	5, 10, 25, 100 lb.
		50% solution	1, 5, 15, 30, 55 gal.
Chemicals, Inc., 1217 W. 37th St., Chicago, Ill.	Chicago, Ill.	50% solution	5, 10, 25, 55 gal.
Charles Cooper & Co., 194 Worth St., New York City	Newark, N.J.	Granulated	100, 400 lb.
		50% solution	10, 50 gal.
E. I. du Pont de Nemours & Co., Inc., Wilmington, Del	Wilmington, Del. Chicago, Ill Cleveland, Ohio (Also a number of other points)	Granulated	10, 50, 490 lb.
		50% solution	12, 55, 110 gal.
General Chemical Co., 105 W. Madison St., Chicago, Ill.	Chicago, Ill.	50% solution	Drums
The Globe Chemical Co., Inc. St. Bernard, Cincinnati, Ohio.	Cincinnati, Ohio Louisville, Ky. Reading, Ohio.	Granulated	Various
The Harshaw Chemical Co., 1945 E. 97th St., Cleveland, Ohio.	Cleveland, Ohio Elyria, Ohio Philadelphia, Pa. Pittsburgh, Pa. New York City Detroit, Mich. Chicago, Ill.	Granulated	10, 25, 50 100 lb.
Hummel Chemical Co., Inc. 90 West St., New York City	New York City	Granulated	10, 25, 50, 100, 475 lb.
		50% solution	Small and large
Industrial Sales Corp., 60 E. 42nd St., New York City	New York City Philadelphia, Pa. Boston, Mass. Baltimore, Md. Norfolk, Va. New Orleans, La.	Fused	880 lb.

Company and address	Location of branch offices, distributing points, and plants	Form (See note at end of list)	Units in which obtainable
Innis, Speiden & Co., 117 Liberty St., New York City	Chicago, Ill. Boston, Mass. Cleveland, Ohio Philadelphia, Pa. Jersey City, N.J. New York City	Granulated	25, 50, 100, 500, 600 lb.
Jordan Co., 2630 W. Arthington St., Chicago, Ill.	Chicago, Ill. Los Angeles, Calif. San Francisco, Calif. Long Island City, N.Y. Seattle, Wash.	Granulated 50% solution	10, 25, 50, 100, 700 lb. 5, 10, 25, 50, 100 lb. 55 gal.
Charles Lennig & Co., Inc., 222 W. Washington Square, Philadelphia, Pa.	Philadelphia, Pa.	72% solution	12, 35 gal.
Mallinckrodt Chemical Works, 2nd & Mallinckrodt Sts., St. Louis, Mo.	St. Louis, Mo. Jersey City, N.J. New York City	Granulated 48-1/2% solution	5, 25, 50, 600 lb. 25, 50, 150 lb.
Merck & Co., Rahway, N.J.	Rahway, N.J. Philadelphia, Pa. New York City St. Louis, Mo.	50% solution	1, 5, 25, 50, 150 lb.
Merrimac Chemical Co., Everett Station, Boston, Mass.	Boston, Mass.	50% solution	5, 13 gal. 700 lb.

Note: The forms and units in which zinc chloride is obtainable from the companies are listed principally for the information of small consumers. Most of the companies furnish the chemical in larger units than those listed. Two companies are reported as marketing zinc chloride in the fused form only. Some of the companies marketing either the granulated or solution form, or both, can also supply fused zinc chloride. Few of them will furnish the fused chemical in small units, however. Without suitable facilities, which is often true of small consumers of zinc chloride, it is generally not very convenient to use or store the fused form. For this reason small consumers will generally find it advantageous to use the granulated or solution forms.

This list of producers and dealers, which is undoubtedly incomplete, is prepared merely for the information of correspondents, and the inclusion of names in it implies no endorsement as to quality and prices.

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